



BANK OF ENGLAND

Speech

Watching the watchers: forward-looking assessment and challenge of a central bank's own financial risks

Speech given by

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Introduction

Thank you very much for the opportunity to speak to you today.

The theme of this conference has been how to understand, and respond to, ever more diverse risks: from the rise of populism and geopolitics to the opportunities and threats of new technology; from new forms of financial risk in banks, capital markets and further afield, to the latest trends in stress testing.

Central banks of course worry about these things too, in pursuit of monetary and financial stability. Indeed we are so good at worrying, we may be one of the few groups of people that can make Chief Risk Officers look chilled out by comparison! But historically, for the Bank of England at least, much of that anxiety has been outward-facing, focused on the ways in which private sector balance sheets might overheat, rather than on our own financial exposures. And that reflects the fact that for long periods in the past, our market operations were relatively simple and low-risk.

All of that has changed in recent years as central banks have taken exceptional actions to stabilise economies and financial systems, driving a huge expansion in the scale and complexity of our market operations and balance sheet exposures. Those actions have delivered vital policy outcomes. But they have also led to entirely appropriate demands for central banks to demonstrate the highest levels of professionalism, transparency and accountability in their management of what are, ultimately, public exposures.

As Executive Director at the Bank of England in charge of our second line financial risk function, I want to explain how we have responded to these developments: setting out the new framework, structures and tools that we have put in place to monitor and challenge our own financial risk – and illustrating them with some practical case studies. A central goal of our work has been to apply the latest thinking in private sector risk management wherever we can. But that has also highlighted a number of areas where central banks have to handle risk in very different ways to commercial banks. Drawing out those similarities and differences will be a key subsidiary theme of my remarks, and will I hope help frame a lively discussion later in our session today.

Central banks as financial firefighters

Let me start with two of the most profound differences, because they colour everything that follows.

The first is that **central banks use their balance sheets not, like commercial banks, to generate economic returns for their shareholders, but to deliver the policy goals of monetary and financial stability**. That may sound innocent enough: dull even. But that would be misleading – because

maintaining stability means central banks must be prepared to act like financial firefighters – rushing into burning buildings (taking on certain types of financial risk) when everyone else is rushing out.

That dynamic is clearest when central banks act as lenders of last resort: stepping in to provide temporary liquidity (to individual firms, or the market as a whole) when private liquidity providers take fright. They are uniquely able to do this because their ability to create fiat money means they face no liquidity risk in their own currencies of issue. Of course, central bankers go to great lengths to limit the other forms of risk they take on in such circumstances: lending only to institutions assessed as solvent and viable; taking high-quality collateral, with conservative haircuts; charging suitably penal interest rates; and typically lending only for limited periods. But they can still find themselves lending, sometimes in large size, when everyone else prefers not to, in order to limit the financial instability that would be caused by wider contagion.

That inversion of the normal definition of risk tolerance – illustrated schematically in **Chart 1** – is strike one against the risk professional’s standard operating manual.

Strike two comes from the fact that **central banks are not subject to financial solvency constraints in the way that commercial banks are**. And that, again, is because their ability to create fiat money means they can always meet liabilities denominated in our own currencies. As a result, there is nothing impossible about a central bank trading with negative capital. Indeed, some (particularly those defending foreign exchange rate pegs) have done just that (**Table 1**).

Chart 1: Central banks as financial firefighters

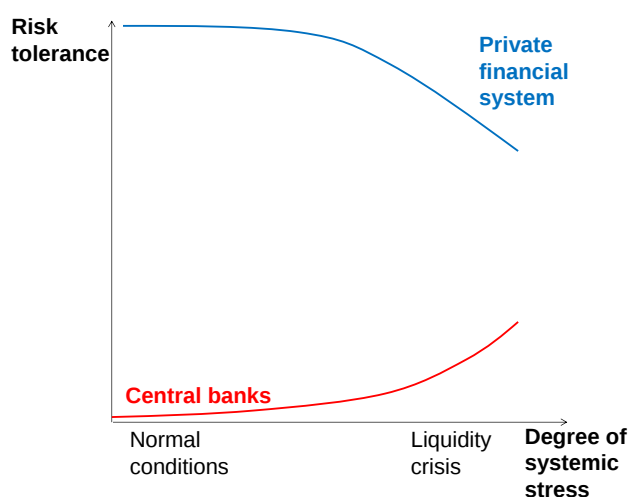


Table 1: Example central bank equity ratios

	Equity / Total assets (%)
European Central Bank	16
Swiss National Bank	10
Bank of Japan	2
US Federal Reserve	1
Bank of England	1
Bank of Israel	–6
Central Bank of Chile	–7

Source: International Monetary Fund; Bank of England; central bank financial statements

Equity and total assets are measured on an accounting basis so do not account for factors such as off-balance sheet exposures or government indemnities. Balance dates are February 2016 for the Bank of England, March 2016 for the Bank of Japan and end 2015 for other central banks.

But before you all rush to sign up as central bank Chief Risk Officers, free forever from the headaches of commercial capital management, a word of caution. Central banks cannot create money willy-nilly without imperilling inflation, undermining their own monetary stability goals. They typically only lend large amounts on a secured basis – so their lending is limited by the supply of collateral available in the private sector. And, perhaps most profoundly of all, weakly capitalised central banks may find it hard to convince markets that they retain the ability to pursue their broader policy objectives without potentially costly recourse to fiscal resources, or further currency debasement. These limits on central bank balance sheet expansion – sometimes referred to as ‘policy solvency’ constraints¹ – can be every bit as binding as financial solvency requirements.

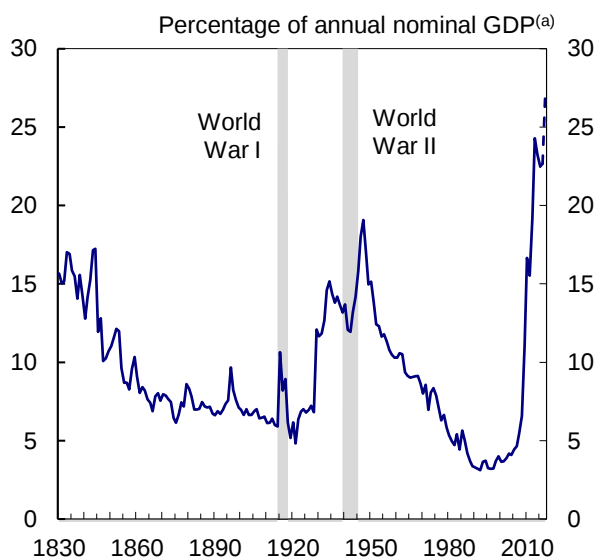
Recent developments in the Bank of England’s own financial risks

Despite central bankers’ readiness to enter burning buildings, and the lack of a binding financial solvency constraint, the Bank of England’s balance sheet was actually very modestly sized in the decades leading up to the financial crisis, at less than 5% of UK GDP (**Chart 2**). The Bank did provide emergency assistance in the mid-1980s and early 1990s², but (by recent standards at least) those exposures were small and short-lived. Other than that, the Bank primarily held high quality, low-duration assets to back a relatively stable stock of sterling banknotes and commercial bank reserves. Financial risk management – though always core to the Bank’s thinking – was not a particularly complex or resource-intensive activity.

¹ For more on this issue, see for example ‘Central bank financial strength, transparency and policy credibility’ by Peter Stella (IMF Staff Papers, Vol. 52, No.2), available at <https://www.imf.org/external/pubs/ft/wp/2002/wp02137.pdf> and ‘Central bank finances’ by David Archer and Paul Moser-Boehm (BIS Papers, No.71), available at www.bis.org/publ/bppdf/bispap71.htm.

² See page 31 of the *Bank of England Report and Accounts 1985* (<http://www.bankofengland.co.uk/archive/Documents/historicpubs/ar/1985accounts.pdf>) and Balluck, K, Galiay A, Ferrara, G and Hoggarth, G (2016), ‘The small bank failures of the early 1990s’ (<http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/2016/q1/a5.pdf>).

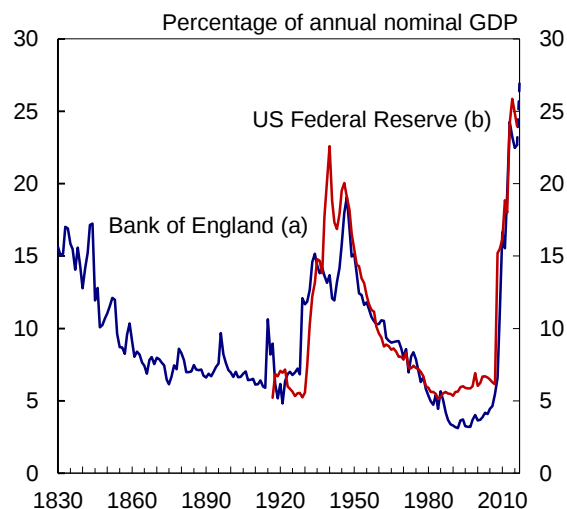
Chart 2: Bank of England balance sheet



Sources: Bank of England, ONS

(a) Data as at February. Final data point shows the latest published balance sheet data, at 29 February 2016, plus the increase in the loan to the Asset Purchase Facility since this time. Excludes TARGET balances held at the Bank by European central banks in 1999-2001.

Chart 3: Federal Reserve and Bank of England balance sheets compared



Sources: Bank of England, Federal Reserve, U.S. Bureau of Labour Statistics, ONS and Samuel H. Williamson (2017), 'What Was the U.S. GDP Then?'.

(a) Data as at February. Final data point shows the latest published balance sheet data, at 29 February 2016, plus the increase in the loan to the Asset Purchase Facility since this time. Excludes TARGET balances held at the Bank by European central banks in 1999-2001.
(b) Consolidated assets of all Federal Reserve banks. Data as at end December.

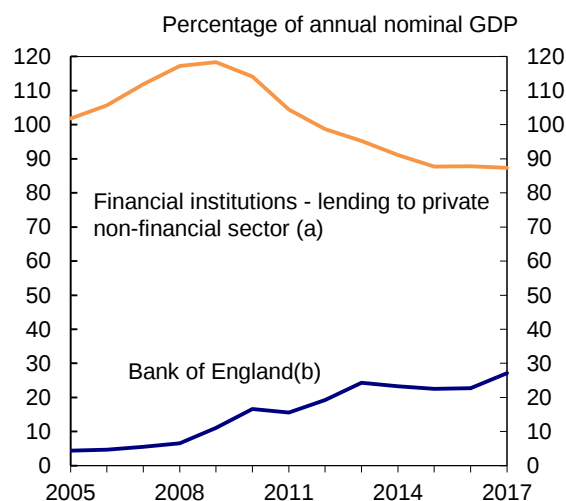
Three key developments disturbed that calm, and led to the introduction of our new financial risk framework. The first was the **huge increase in the size of the Bank's balance sheet** following the start of the financial crisis. Today the Bank of England holds assets worth about a quarter of UK annual GDP: a five-fold increase on a decade earlier (**Chart 2**). In the early part of the financial crisis, much of that increase reflected large scale liquidity assistance to the banking sector. For example the Bank lent £61.5bn to RBS and HBOS in 2008-9³, and its market-wide Special Liquidity Scheme peaked at £185bn in 2009⁴. More recently, the balance sheet expansion has primarily reflected outright asset purchases and long-term lending schemes of unprecedented scale and duration, designed to deliver monetary stability when interest rates are close to zero. Other major countries have seen increases of similar scale: **Chart 3** for example compares the expansion in the Bank's balance sheet with that of the US Federal Reserve.

These expansions, though primarily focused on maintaining monetary rather than financial stability, are arguably further examples of the central bank as firefighter: injecting liquidity when other market-based channels are blocked. **Chart 4** shows how closely the increase in the size of the Bank's balance sheet mirrors the decrease in the scale of sterling lending to households and firms by UK banks in recent years: a strikingly similar picture to the stylised relationship in **Chart 1**.

³ For a discussion, see for instance Ian Plenderleith's *Review of the Bank of England's Provision of Emergency Liquidity Assistance in 2008-09* (<http://www.bankofengland.co.uk/publications/Documents/news/2012/cr1plenderleith.pdf>).

⁴ See John, S, Roberts, M and Weeken, O, 'The Bank of England's Special Liquidity Scheme' (<http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb120105.pdf>).

Chart 4: UK central and commercial bank balance sheets

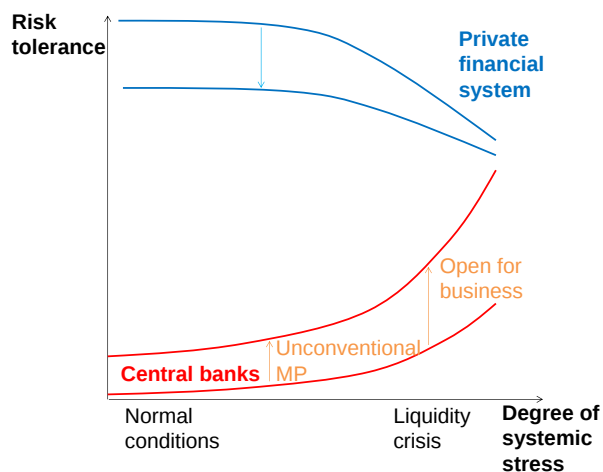


Sources: Bank of England, ONS

(a) Data as at February. Sterling net lending to non-financial corporations and household sector.

(b) Data as at February. Final data point shows the latest published balance sheet data, at 29 February 2016, plus the increase in the loan to the Asset Purchase Facility since this time.

Chart 5: Permanent shift in the Bank's firefighter role?



The financial instruments underpinning these expansions tend not to be particularly complex when compared to those on commercial bank balance sheets. But the Bank of England has also accumulated material new **contingent exposures**, reflecting its much wider post-crisis range of policy responsibilities, and a more comprehensive liquidity insurance toolkit. The Bank's new responsibilities for banking supervision, macro-prudential policy and resolution imply a range of potential new calls on its balance sheet. And operational reforms designed to address the deficiencies in the Bank's pre-crisis lending tools and flag clearly that the Bank was 'open for business'⁵, have left the Bank capable of lending to a wide range of banks and non-banks, against many different types of collateral, at lower prices, and through a broad range of facilities. As of 2016, members of the Bank's Sterling Monetary Framework – our main liquidity-providing tool – had pre-positioned over £400bn of collateral with us, including 30% of the UK's total stock of household mortgage loans. Only a fifth of that collateral had been drawn against, through the Funding for Lending Scheme and other Bank facilities. Even after accounting for the Bank's sizeable haircuts, that leaves well over £250bn of available credit: a much higher proportionate level of contingent exposure for the Bank than typically incurred by commercial banks through undrawn facilities. So our balance sheet may expand in both scale and riskiness at times of heightened liquidity stress: the Bank of England's role as financial firefighter has shifted permanently upwards (**Chart 5**).

⁵ See <http://www.bankofengland.co.uk/publications/Documents/news/2012/cr2winters.pdf>; and the Bank's new framework at <http://www.bankofengland.co.uk/markets/Documents/money/publications/liquidityinsurance.pdf>. The reforms are summarised in a speech by the Governor at <http://www.bankofengland.co.uk/publications/Pages/speeches/2013/690.aspx>.

The third key driver behind our new risk framework has been the **strong public demand for greater accountability and transparency from central banks since the financial crisis**. In large part, that demand follows directly from the increased breadth and scale of central banks' responsibilities and financial exposures. But in the Bank of England's case the desire to build a strengthened financial risk framework also reflects an important consequence of taking on responsibility for the micro-prudential regulation of banks, which is that we should be willing to do unto ourselves as we would do unto others: a Golden Rule for central bankers. And it reflects a strong desire to investigate new ways of driving innovative analysis and lean against the risks of groupthink.

Strengthening the Bank of England's financial risk framework

The Bank has had strong first- and third-line financial risk functions for some time. An expert first-line team assesses, prices and haircuts the wide range of collateral pre-positioned with us, monitors the specific risks taken in live operations on a day-to-day basis, and evaluates the financial condition of our counterparties, liaising with our supervisory colleagues in the Bank's Prudential Regulation Authority arm⁶. And internal and external auditors regularly assess the effectiveness of the Bank's financial controls.

Until recently, however, the Bank has not had a dedicated second-line financial risk function, reflecting a perception that central banking operations did not give rise to tensions of the sort seen between profit making and risk control in private firms. The amount of residual risk to which the Bank was actually exposed, after taking account of large collateral haircuts and government indemnities, was also felt to be relatively small.

As the scale of the Bank's balance sheet persisted however, it became increasingly clear that we needed to do more to bring our risk framework up to best practice. That was for three main reasons, each linked to the drivers I listed a moment ago. First, the increasing complexity of the Bank's operations meant that we needed more effective ways to measure the risks we were taking, add them up across the different specific operations, and evaluate them against an explicit statement of the Bank's risk tolerance. Second, the increasingly contingent nature of our risks meant we needed much better forward-looking tools for evaluating how those risks might crystallise in different scenarios, and ensuring we had sufficient resources to respond. And, third, the need to hold ourselves accountable, identify potential blindspots and safeguard against groupthink in our internal work, required more effective internal challenge and reporting mechanisms.

In the summer of 2015, we therefore set up a brand new second line financial risk challenge function, staffed using some of our risk experts who previously helped the PRA to challenge commercial banks: bringing the 'Golden Rule' to life. We developed a framework of risk tolerance, measurement, assessment, reporting and challenge tools across the full range of credit, market, counterparty and liquidity risks facing the Bank, basing

⁶ More details on these functions are available in the Bank's annual report on the Sterling Monetary Framework, available at <http://www.bankofengland.co.uk/markets/Documents/smf/annualreport16.pdf>.

them where possible on industry best practice. And we agreed a new governance structure, giving the second line a key role as independent counsel to our Board's Audit and Risk Committee, establishing a new Executive Risk Committee and working-level challenge forums, and securing space for risk challenge on all new policy proposals.

Now all of this will sound very familiar to you as risk professionals – and that in a sense is the point. In some cases, it is just central banks catching up! But in other cases we have had to blaze a new trail – reflecting the unusual nature of some aspects of risk management at a central bank. To illustrate those points, let me take you through a few brief case studies of specific issues we have dealt with in our early months of operation.

The new second line in action: five case studies

(i) Purchases of government debt for monetary policy purposes ('Quantitative Easing')

The introduction of the new second line has in some cases primarily formalised and hardwired approaches which had already been evolving as the balance sheet expanded.

By far the largest single item on the Bank's current balance sheet reflects the outright holding of some £360bn of UK government bonds (or 'gilts') in notional terms, purchased on behalf of the Bank's Monetary Policy Committee as part of the implementation of their unconventional monetary policy – often known as 'quantitative easing'. This is by any standards a large portfolio – amounting to about a third of the total stock of conventional gilts in issue, with an average duration of 12 years, it has a so-called 'PV01' – or valuation sensitivity to a one basis point movement in average interest rates – of about £450mn⁷.

Now an open position of this size would be many times larger than even the most aggressive traders in this room would dream about running themselves. Your natural instinct as a risk professional if you came across this in the private sector would probably be to seek an immediate reduction in the position, or a hedge in the market. But any attempt to do this would undermine the very policy objective of the Monetary Policy Committee in pursuit of their 2% inflation target: ie to induce a portfolio shift into riskier assets by removing duration from the market. As I noted earlier, this is a classic example of the central bank policymaker as fireman.

What then is the role for the central bank financial risk function? For the new second line, it is a classical watching brief. Its first duty would have been to ensure there were sufficient resources to back the risk. In this case, that was achieved some years ago by placing the portfolio in a separate subsidiary of the Bank

⁷ For more details on the current composition of the APF gilt portfolio and the operations, see <http://www.bankofengland.co.uk/markets/Pages/apf/gilts/results.aspx>.

backed by a government indemnity⁸. The Bank's exposure then consists simply of an overnight loan to that subsidiary, matched against its primarily short-term liabilities (**Table 2** illustrates this using the last published accounts), and the government has a natural hedge for its indemnity in that changes in interest rates have partly offsetting effects on the value of the indemnity and the cost of new debt issuance.

The other task for the second line financial risk function is to ensure that there is adequate transparency for policymakers, government and the public over how the exposures can change over time, under different scenarios, so that future decisions are made with full information. That is done – as it has been since the onset of quantitative easing – through multiple channels, including periodic internal reports to the Bank's Court and HM Treasury, and external analysis and data, including in the Bank's Quarterly Bulletin and the BEAPFF annual accounts. As of January 2017, the fund had generated about £70bn⁹ in net interest income, sufficient to cover the mark-to-market impact of a material increase in interest rates.

Table 2: 2015/16 Bank of England and BEAPFF balance sheets¹⁰

Bank of England Consolidated Balance Sheet (£bn)		BEAPFF Balance Sheet (£bn)	
29-Feb-16		29-Feb-16	
Assets		Assets	
Loans and advances	402	Cash	1
o/w Loan to APF	375	Debt Securities	413
Securities held at fair value	7	Total Assets	415
Available for sale	11		
Other assets	2	Liabilities	
Total assets	423	Loans and other borrowings	375
		Due to HM Treasury	39
Liabilities		Total liabilities	415
Deposits	345		
Notes in circulation	68		
Foreign currency bonds in issue	4		
Other liabilities	1		
Capital and reserves	5		
Total equity and liabilities	423		
Off balance sheet			
FLS drawdowns	58		

⁸ For more details, see the Bank of England Asset Purchase Facility Fund Limited Annual Report at <http://www.bankofengland.co.uk/publications/Documents/other/markets/apf/boeapfannualreport1606.pdf>.

⁹ Not including unrealised mark to market profits. Data available in Appendix A of <https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/publicsectorfinance/bulletins/publicsectorfinances/jan2017>.

¹⁰ See <http://www.bankofengland.co.uk/publications/Documents/annualreport/2016/boereport.pdf> and <http://www.bankofengland.co.uk/publications/Documents/other/markets/apf/boeapfannualreport1606.pdf>.

(ii) Forward looking stress tests of the Bank's financial exposures

If the first case study illustrated an example where risk was already being actively evaluated, my second illustrates a completely new area of activity.

The concept of enterprise-wide stress tests has transformed private sector thinking on risk management in recent years, driven in many cases by central bank regulators. The Bank of England conducts an extensive annual supervisory stress testing programme in the United Kingdom – and I note with interest the discussions taking place elsewhere in this conference on the potential to expand such exercises well beyond banks, something we have also been considering¹¹.

But, ironically perhaps, the Bank of England has not until very recently applied such techniques to its own balance sheet. That made sense when large-scale balance sheet expansions were expected to be rare and highly idiosyncratic. But the more permanent shift in the Bank's firefighter role illustrated in **Chart 5** suggests we need a more sophisticated, agile forward-looking way of evaluating the risks we might face, and (importantly) the resources required to deal with them. Development of a suite of stress tests has therefore been a core part of the early work of the new second line team.

To shape this work, key judgments are required on 'the 3 'S's': Scope, Scenarios and Severity. **Scope** describes the range of facilities that the Bank might be called upon to use. This is a challenging judgment for an organisation specialising in tail risk insurance, and with a broad policy remit – but initially we have focused on the public commitments to provide market-wide and firm-specific liquidity insurance through the Bank's current set of facilities and operations. The **scenarios** we have so far explored are also consistent with this scope, and include examples of both domestic and international shocks, affecting banks, non-banks and capital markets. Wherever possible these are based on the scenarios used by the Bank's supervisors in their work with industry, but with typically higher **severity**: consistent with the assumption that firms should be capable of surviving supervisory stress tests using their own resources. It is only when firms' liquidity needs go beyond the level that could reasonably be covered by their own resources that the central bank is called upon to act in size: the image of the firefighter in action once again.

So what do we do with the results of this work? In the private sector, of course, stress tests are used to inform desired capital levels, and that is certainly something we consider too. But they can also have a wider influence, as we found last year when we ran an exercise to evaluate the potential implications of uncertainty surround different possible outcomes of the UK referendum on membership of the European Union. The results of that work helped to inform judgments on collateral pre-positioning and haircuts, engagement with fellow central banks, and our own supervisory actions and conversations. Most importantly of all, it confirmed that the Bank had sufficient lending capacity in place to meet an extremely severe liquidity shock,

¹¹ See for instance: <http://www.bankofengland.co.uk/publications/Documents/speeches/2017/speech960.pdf>.

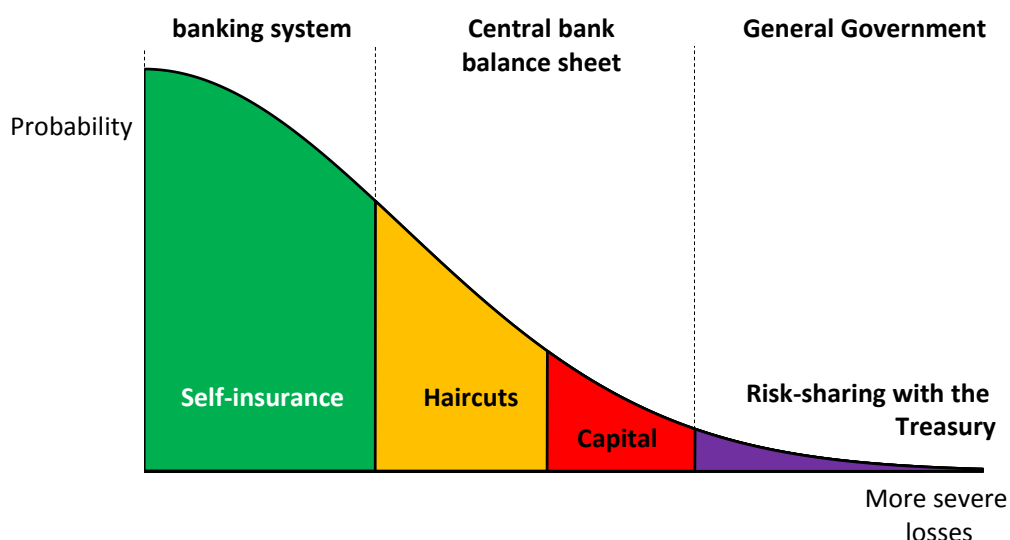
which allowed the Bank to make reassuring statements about its readiness to act. In the event no such shock occurred. But the Bank's preparedness played a part in that. Just as we expect firms to be ready for the unexpected, we hold ourselves to the same standard.

Indeed this exercise drove home an important broader point: for central banks to be effective watchmen (all the time) and firefighters (occasionally), we first need private sector risk managers to have drawn up (and shared with us) their own fire precaution and exit route plans. Without a good understanding of firms' potential liquidity needs under stress, their alternative sources of liquidity and available collateral we cannot fully evaluate our own capacity to lend. This sort of liquidity planning under stress is I know an increasing focus for both banks and non-banks alike, and is something we would actively encourage.

(iii) Calibrating the Bank's own capital

I mentioned at the start of my remarks that central bank capital is different to that of a commercial bank: central banks need to meet a 'policy solvency' rather than a 'financial solvency' test. It also sits at the base of a particularly steep waterfall: since any loss in a lending operation would be expected to be met, first by a solvent firm's own resources, second by the central bank's collateral haircuts, and only then by its capital. Any loss beyond that implicitly falls to the government, as the ultimate owner of the central bank (**Chart 6**).

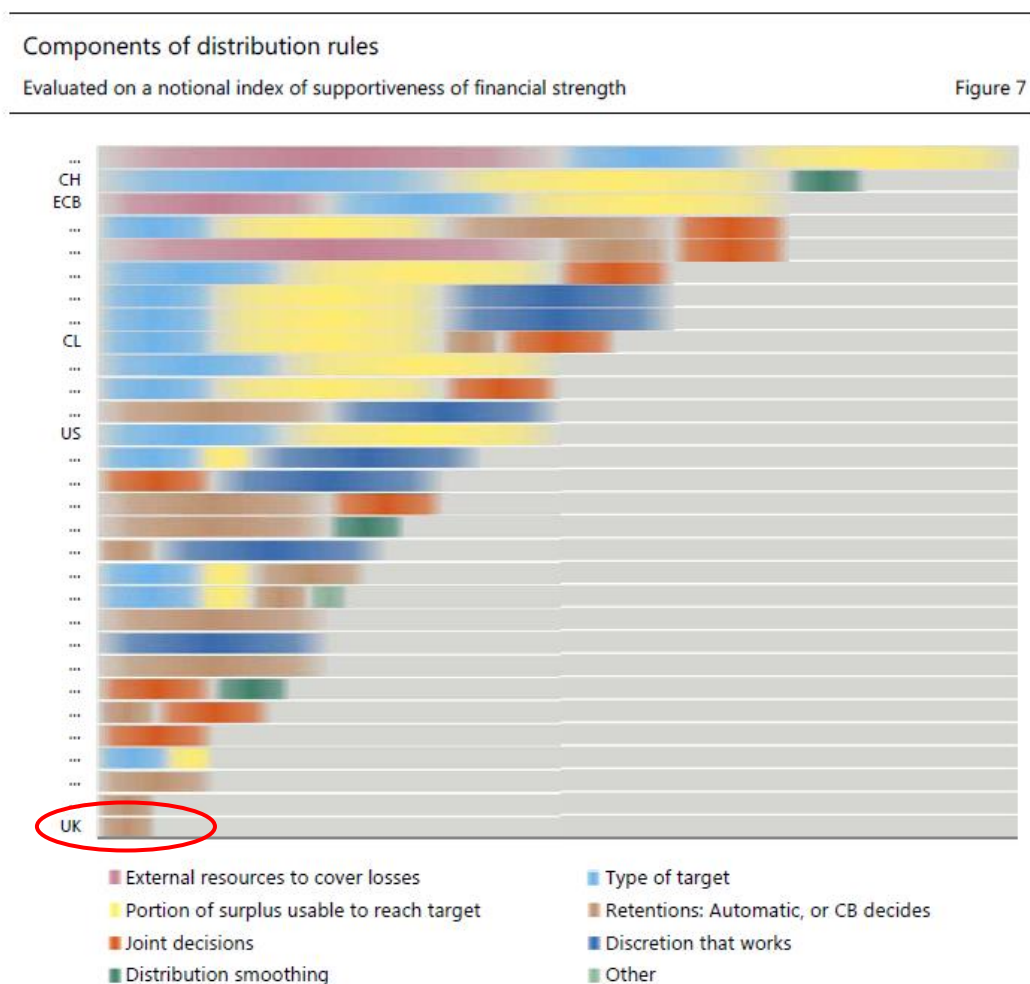
Chart 6: The central bank capital waterfall



Central banks across the globe differ in how they divide up this pie. In the UK, the Bank of England operates with a relatively low level of capital, and has few means of rapidly replenishing that capital if it is depleted (**Chart 7**). As a result it has tended to rely heavily on UK government indemnities for its larger operations, such as the quantitative easing example I gave a few moments ago. The Bank's measured leverage ratio is

just 1%, reflecting the fact that it supports a balance sheet of around £1/2tn on less than £3bn of equity.¹² But the ratio for its non-indemnified balance is materially higher, reflecting the significant role played by indemnities.

Chart 7: Central bank capital replenishment tools¹³



The costs and benefits of these arrangements are quite subtle, and rest heavily on the extent to which the markets and wider public perceive the Bank to have the means to deliver its substantially expanded remit effectively without recourse to money creation, both in today's market conditions and in stressed conditions¹⁴. Comprehensive stress testing, together with the other elements of the forward-looking toolkit

¹² This capital figure consists of 'Capital and Retained Earnings'. It does not include 'Other Reserves' of £1.6bn which are included in accounting capital, but not considered loss-absorbing for regulatory purposes. For more details see <http://www.bankofengland.co.uk/publications/Documents/annualreport/2016/boereport.pdf>.

¹³ Taken from BIS Papers No.71 (see footnote 1).

¹⁴ These issues are also discussed in the IMF's most recent UK Financial Sector Assessment Program review: see Box 1 on p.12 of <https://www.imf.org/external/pubs/ft/scr/2016/cr16159.pdf>.

developed by the Bank's new second line function, have improved our ability to assess the adequacy of these arrangements considerably.

(iv) Risk tolerance, limits and thresholds

Board-level risk tolerance statements, and the specific trading and lending limits associated with them, are amongst the risk manager's most powerful tools. But the calibration of both is an art as much as a science, reflecting the difficulty of defining precise tolerance measures, and (in commercial banks) the inevitable tension between revenue-generation and risk- or capital-reduction goals.

Applying these tools to central banking operations is both easier and harder than in the private sector. Easier, because there is no tension between profit and risk: central banking operations are always designed with risk in mind from the start. But harder, because the events in which central banks are called on to act often lie in the very tails of the distributions, making it hard – often impossible – to calibrate risk tolerance using historic data. And many of our operations are not discretionary, but reflect policy imperatives: so binding risk limits which, if applied, might cause a policy to be aborted mid-course, have little chance of success.

At the Bank of England, we have responded to these challenges in three ways. First, we have adopted a risk tolerance that, though qualitative in nature, recognises the importance attached to the safeguarding of public resources and the priority placed on ensuring that policy decisions are always made in full knowledge of the financial risk implications. As I have described, maintaining monetary and financial stability – the Bank's policy mission – can sometimes mean we have to take on material levels of risk ourselves. But where we do that, we should take on no more risk than is necessary, and we should do so with our eyes open, conscious too of the tradeoffs between financial and non-financial risk. Second, as I have already discussed, we have developed a toolkit for analysing how far different levels of financial resource can support the Bank's operations under a range of severe but plausible shocks. And, third, we are in the process of designing a tiered, enterprise-wide framework of limits and thresholds, consistent with the resources available to the Bank, which (i) imposes macro-level limits that protect our capital base and (ii) sets a series of early-warning thresholds. These thresholds will not immediately constrain live non-discretionary operations, but they will flag buildups of risk concentrations and trigger internal discussion and review on whether the increase in risk is warranted by policy objectives. That could lead to adjustment of policy parameters, changes to the Bank's financial resources or use of alternative Bank policy levers to mitigate the underlying risks. At a more granular level, nested within these balance sheet wide thresholds, the first line has discretion to impose hard limits on particular discretionary operations where it is feasible to do so (eg. on the Bank's limited own-funds foreign exchange reserves operations).

(v) Challenging new policy initiatives

One of the most profound changes to private sector risk management practice since the financial crisis has been the near-universal introduction of processes to ensure that the business and risk implications of new and sometimes complex products are fully understood before they can be launched.

Central banks are unlikely to come with anything as complex or potentially toxic as the CDO-squared or cubed! But as I have covered in some detail, central bank operations frequently pose complex risk issues of their own. Take the example of the collateral available to support our contingent lending for liquidity support, and how to estimate the central bank's exposure to that. The closest this would get to in a commercial firm is a Potential Future Exposure (PFE) calculation. However most risk managers are used to considering PFE in the context of counterparty exposure through OTC derivatives instruments – which is challenging enough! But for us the underlying instrument is not a derivative product with a reasonable amount of pricing information available: it is a set of non-traded mortgage portfolios, which have to be marked to market today and at future points in time. So this is what we have to evaluate: a PFE where the underlying is a pool of marked-to-market mortgage portfolios lacking readily-available market pricing data. In response, we have had to develop robust valuation models linking observable macro-economic variables to potential exit prices, whilst being honest about the range of uncertainty around these estimates. And the Golden Rule applies in this case too – in the form of independent model validation by our own specialist risk supervisors.

While central banks do not typically have a profit/risk tradeoff, they do have to trade off the risk taken against the policy objectives being pursued. Unlike profits, there is no single measure of policy effectiveness, but a wide range of economic and financial indicators to analyse. Whilst such tradeoffs always took place more or less explicitly at the Bank, the introduction of the new second line financial risk function has allowed us to put a much clearer structure around them, institutionalise a process of professional risk challenge at working level, and provide for rigorous and independent advice to policymakers.

Just as this process brings implementation challenges, I know, in your own organisations, so it has at the Bank. Maintaining separation between first and second line, when today's risk challenge may become tomorrow's design feature, for example. Ensuring that robust and comprehensive advice is provided on policies where time to market can be very short, and policy design is itself moving rapidly. Or securing airtime to ensure risk considerations are properly discussed. But we successfully applied the new processes to the Bank's recently-announced Corporate Bond Purchase and Term Funding monetary policy schemes, working with the first line to ensure that the key drivers of financial risk associated with the new facilities were identified and where appropriate mitigated from the start, and underscoring the importance of taking no more risk than required to deliver the policy objective.

Conclusions

In the time available, I have only scratched the surface of what can be achieved through the application of modern risk management techniques to central banks' own financial exposures. There are some profound differences between central bank risk management and that in the private sector: in particular, the lack of a hard financial constraint, the inverted risk tolerance in times of stress and the dominant influence of policy imperatives. But there are also many areas where we have been able to gain enormously from the straightforward adoption of best-practice market techniques, including stress testing, risk tolerance and limit structures, and a wide range of risk review standards.

What are the next challenges? As I alluded to before, risk managers and CROs in commercial firms are upstream from us in the chain of defences in the global financial system. This means that the more you can do to throw light on your organisations' potential liquidity needs under stress, and the potential mitigants for that stress, not only will it help you and your supervisors, it will also help central banks to be better watchmen for tail events, and more effective firefighters if the building ever needs to be evacuated.

My second main message is that, we are also members of the wider risk management community, dealing with similar concepts and sometime identical products, but with a different perspective. So we look forward to a rich and ongoing dialogue with you as you develop better and more robust ways to manage and diversify risk.